Final synopsis

A comparative study of non-verbal creative thinking ability amongst IXth grade students studying in English and Marathi Medium of Aurangabad City

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A Final Synopsis Submitted for the award of the degree Doctor of Philosophy
in the subject of Education under the Faculty of Interdisciplinary Studies

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1. Introduction

This comparative study examines the non-verbal creative thinking ability of ninth-grade students studying in English and Marathi mediums in Aurangabad City, Maharashtra, India. The research questions explore significant differences in figural creative thinking ability based on the medium of instruction, gender, and the interaction between medium and gender. The objectives of the study are to assess and compare the figural creative thinking ability of students in both mediums and to examine the impact of gender on creative thinking ability.

The study utilizes the Baquer Mehdi Figural Creativity Test to measure figural creative thinking ability. The hypotheses test for significant differences in total creativity scores, as well as scores for elaboration and originality, between Marathi medium and English medium students, and between Males and Females within each medium.

The research design involves a random sampling survey method, with a sample size of 622 ninth-grade students from Marathi and English medium schools in Aurangabad City. Data collection includes self-reporting sheets and the administration of the Baquer Mehdi Figural Creativity Test. Data analysis involves descriptive statistics, t-tests., The findings indicate significant differences in non-verbal creative thinking ability between male and female participants, with females demonstrating higher scores. However, no significant differences were found between Marathi medium and English medium students or between Males and Females within each medium. These results suggest the presence of gender-related differences in creative thinking ability, but further research is required to explore underlying factors.

This study contributes to the understanding of non-verbal creative thinking ability among ninth-grade students in different mediums of instruction. The findings have implications for educators and policymakers in designing effective instructional approaches and interventions to foster creativity. Future research can explore additional factors influencing creative thinking ability and investigate other aspects of creativity and cognitive abilities.

2. Need of the research

The ability to think creatively is a critical skill in the modern era, where innovation and problem-solving are highly valued across educational, professional, and societal contexts. Among various dimensions of creativity, non-verbal creative thinking ability—especially in figural contexts—plays a significant role in enabling students to process information, generate novel ideas, and express creativity through visual and non-linguistic mediums.

Language and medium of instruction are often regarded as influential factors in cognitive and creative abilities. However, there is limited research on how the medium of instruction, particularly in bilingual or multilingual regions like Aurangabad City, Maharashtra, affects non-verbal creative thinking ability. Aurangabad, being a culturally diverse city with students studying in both English and Marathi mediums, offers a unique opportunity to examine these differences in a controlled setting.

Additionally, the role of gender in creative thinking has been a subject of ongoing academic discourse. While some studies suggest that gender may influence creative abilities, the interaction between gender and the medium of instruction in shaping non-verbal creative thinking remains underexplored. This study addresses these gaps by focusing on ninth-grade students—a critical developmental stage where creativity begins to solidify as an essential skill.

The findings of this research are essential for several reasons:

Educational Insights: Understanding the impact of the medium of instruction and gender on creative thinking can inform curriculum design and teaching methodologies to foster creativity in students.

Policy Development: The study's results can guide policymakers in creating targeted interventions to enhance creative thinking abilities across diverse educational settings.

Gender Equity: By exploring gender-related differences, the research highlights areas where efforts are needed to promote equitable learning opportunities for both Males and Females.

Cultural Relevance: This study contributes to the understanding of how linguistic and cultural factors interact with cognitive abilities in the Indian context, offering localized insights for educators and researchers.

By employing robust methods such as the Baquer Mehdi Figural Creativity Test and analyzing data from a diverse sample of 622 students, this study seeks to provide evidence-based conclusions about the interplay of medium of instruction and gender on non-verbal creative thinking ability. The findings will serve as a foundation for future research and practical applications, ultimately enriching the educational experience of students in Aurangabad and beyond.

3. Importance of the research

This research holds significant importance as it addresses a critical aspect of educational development—non-verbal creative thinking ability—while exploring its relationship with the medium of instruction and gender. The findings have implications that extend beyond academic discourse, influencing educational practices, policies, and societal understanding of creativity in diverse learning environments.

The importance of this research can be outlined as follows:

1. Enhancing Creative Potential in Students:

Non-verbal creative thinking plays a vital role in problem-solving, innovation, and expression. Understanding its dynamics among students in English and Marathi mediums can help educators identify and nurture creative potential in different educational settings.

2. Addressing Educational Diversity:

In a multilingual and multicultural city like Aurangabad, where students from diverse linguistic backgrounds coexist, this research offers valuable insights into how the medium of instruction influences cognitive abilities. This knowledge is crucial for creating inclusive and effective learning environments.

3. Guiding Curriculum Development:

By identifying strengths and areas for improvement in students' creative thinking abilities, the study can inform curriculum design and teaching strategies that prioritize creativity alongside traditional academic subjects.

4. Understanding Gender Differences:

The research explores how gender affects non-verbal creative thinking ability, shedding light on existing disparities. This understanding can guide targeted interventions to promote gender equity in education.

5. Informing Policymakers:

The findings can aid policymakers in designing educational programs and initiatives that foster creativity in schools. Such programs can contribute to producing future-ready individuals equipped with innovative thinking skills.

6. Contributing to Global Research:

While creativity has been widely studied, research on non-verbal creative thinking in the Indian context, particularly in relation to the medium of instruction and gender, is limited. This study contributes to filling this gap, enriching global literature on creativity and education.

7. Supporting Lifelong Learning:

Creative thinking is not just an academic skill but a lifelong asset. Insights from this study can help educators equip students with the tools to think innovatively and adapt to the ever-evolving demands of society and the workforce.

8. Local and Cultural Relevance:

This research is tailored to the educational landscape of Aurangabad City, providing context-specific insights that can be directly applied to local schools while also serving as a model for studies in other regions.

By addressing these areas, the study underscores the importance of fostering creative thinking in school education. The findings have the potential to shape educational practices, contribute to academic research, and influence policy, ultimately benefiting students, educators, and society at large

4. Research title

A comparative study of non-verbal creative thinking ability amongst IXth grade students studying in English and Marathi Medium of Aurangabad City

5. Operational definitions of important concepts in research title

1. Non-Verbal Creative Thinking Ability:

Assessed using the Baquer Mehdi Figural Creativity Test, which evaluates components such as originality, and elaboration in figural tasks.

2. Student

A Child enrolled in the school and aspiring for knowledge.

2. IXth Grade

IX is one of the secondary-level classes.

3. English Medium

Schools recognized by the educational board as delivering instruction primarily in English in Aurangabad City.

4. Marathi Medium

Schools recognized by the educational board as delivering instruction primarily in Marathi.

5. Aurangabad City

A city located in the state of Maharashtra, having

6. Comparative Study

A research approach aimed at identifying similarities and differences in the non-verbal creative thinking abilities of students from different mediums of instruction.

6. Assumptions of the research

1. Creativity is an essential component in child development
2. Intelligence and Creativity are different psychological aspects
3. Creativity is important in overall educational development of the student
4. Creativity has two types i) Verbal and ii) Non-Verbal
5. The syllabus for Marathi and English medium state board schools is the same.

7. Objectives of the research

1. To compare the total figural creative thinking ability of ninth-grade students studying in Marathi medium and English medium schools.
2. To compare the originality dimension of figural creative thinking ability of ninth-grade students studying in Marathi medium and English medium schools.
3. To compare the Elaboration dimension of figural creative thinking ability of ninth-grade students studying in Marathi medium and English medium schools.
4. To compare the total figural creative thinking ability of ninth grade by gender in both Marathi medium and English medium schools.
5. To compare the originality dimension of figural creative thinking ability of ninth grade by gender in both Marathi medium and English medium schools.
6. To compare the elaboration dimension of figural creative thinking ability of ninth grade by gender in both Marathi medium and English medium schools.

8. Hypothesis of the research

Null Hypothesis

1. There is no significant difference in Total Creativity Scores (T-Score) between students instructed in Marathi and those instructed in English.
2. There is no significant difference in E-Score (one of the dimensions of Total Creativity Score) between students instructed in Marathi and those instructed in English.
3. There is no significant difference in O-Score (one of the dimensions of Total Creativity Score) between students instructed in Marathi and those instructed in English.
4. There is no significant difference in Total Creativity Scores (T-Score) between males and females.
5. There is no significant difference in E-Score (one of the dimensions of Total Creativity Score) between males and females.
6. There is no significant difference in O-Score (one of the dimensions of Total Creativity Score) between males and females.

Alternative Hypothesis

1. There is a significant difference in Total Creativity Scores (T-Score) between students instructed in Marathi and individuals instructed in English.
2. There is a significant difference in E-Score between individuals instructed in Marathi and students instructed in English.
3. There is a significant difference in O-Score between students instructed in Marathi and students instructed in English.
4. There is a significant difference in Total Creativity Scores (T-score) between males and
5. There is a significant difference in E-Score between males and females.
6. There is a significant difference in O-Score between males and females.

9. Scope of the research

1. Scope of Area

The research is geographically confined to Aurangabad City.

2. Scope of content

The study investigates non-verbal creative thinking ability. The components of creative thinking assessed include originality and elaboration as measured by the Baquer Mehdi Figural Creativity Test.
The research examines differences in creative thinking abilities based on:
Medium of Instruction: English and Marathi.
Gender: Male and. Female.
Interaction Effects: Combined influence of medium of instruction and gender on non-verbal creative thinking.

3. Scope of Unit

This research is related to non-verbal creative thinking ability of IXth grade students.

10 Limitations of the research

1. Limitation of Area

This research is limited up to Aurangabad District only.

2. Limitation of content

This research is limited to the non-verbal creative thinking ability of IX grade students of state board.

3. Limitation of the unit

The research is limited to only non-verbal creative thinking ability .

4. Limitation of time

This research is limited to the partial fulfilment of degree

Doctorate of Philosophy year 2021-2024

11. Research method

The experimental research design is a widely adopted method in academic research globally, including in India and Western nations. It is primarily used to explore cause-and-effect relationships by manipulating variables under controlled conditions. This method relies heavily on precision, as it employs both qualitative and quantitative approaches. The use of appropriate language and mathematical formulations is critical in experimental design to ensure clarity and accuracy. Experimental research focuses on understanding dynamic changes, analyzing interactions between variables, and interpreting findings in a systematic and meaningful way. It offers valuable insights through controlled comparisons and measurements, providing a comprehensive explanation of the subject matter. Given its focus on causal relationships, the researcher has adopted an experimental research design for this study.

12. Tools of the research

There are various tools of data collection; by studying these tools in depth the researcher has selected a standardized test for the current research.

A self-reporting data collection sheet was provided to each student. The sheet includes information such as age, gender, mother tongue, and medium of instruction (English or Marathi). Some additional variables were also collected like favourite color, blood group, diet preference veg or non-veg. The Baquer Mehdi figural creativity (NVTCT-M) test was administered to each participant to measure their non-verbal creative thinking ability.

Description of the Baquer Mehdi figural creativity test (NVTCT-M)

The Non-Verbal Test of Creative Thinking - Modified (NVTCT-M), developed by Baquer Mehdi, is a specialized psychometric instrument designed to evaluate non-verbal creative thinking ability. This test focuses on the figural aspects of creativity, enabling the assessment of creative potential

Test Format

The NVTCT-M consists of figural tasks that prompt participants to create or complete drawings based on abstract or incomplete shapes.

Tasks include:

1. Completing unfinished figures.
2. Creating original figures using basic geometric shapes.
3. Generating multiple uses or interpretations for visual stimuli.

Participants are provided with clear visual instructions, minimizing the need for verbal explanation, ensuring accessibility for individuals from different linguistic backgrounds.

Scoring System

Each response is scored based on the criteria for originality and elaboration.

A total creativity score is calculated by summing up the scores of originality and elaboration components.

13. Population and Sample

Population

The population of interest comprises IXth grade students studying in both English and Marathi medium state schools located within Aurangabad City. The sampling frame was constructed in collaboration with the educational institutions within the city. This frame includes a comprehensive list of all eligible students from a total of seven different schools representing both English and Marathi medium education.

Sample:

For the present research a total of 622 students were considered as samples for testing using the Baquer Mehdi non verbal test.

Table 1

Gender	English Medium	Marathi Medium	Total
Female	144	149	293
Male	180	149	329
Total	324	298	622

Graph No 1

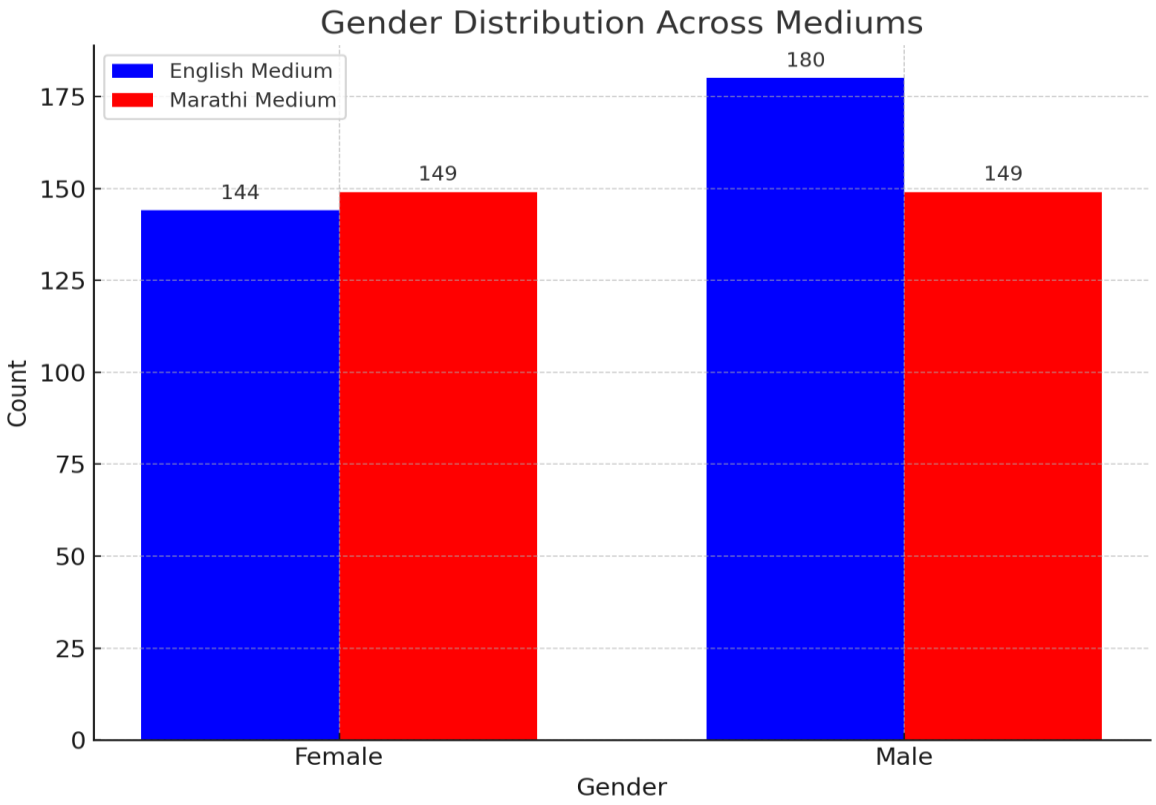
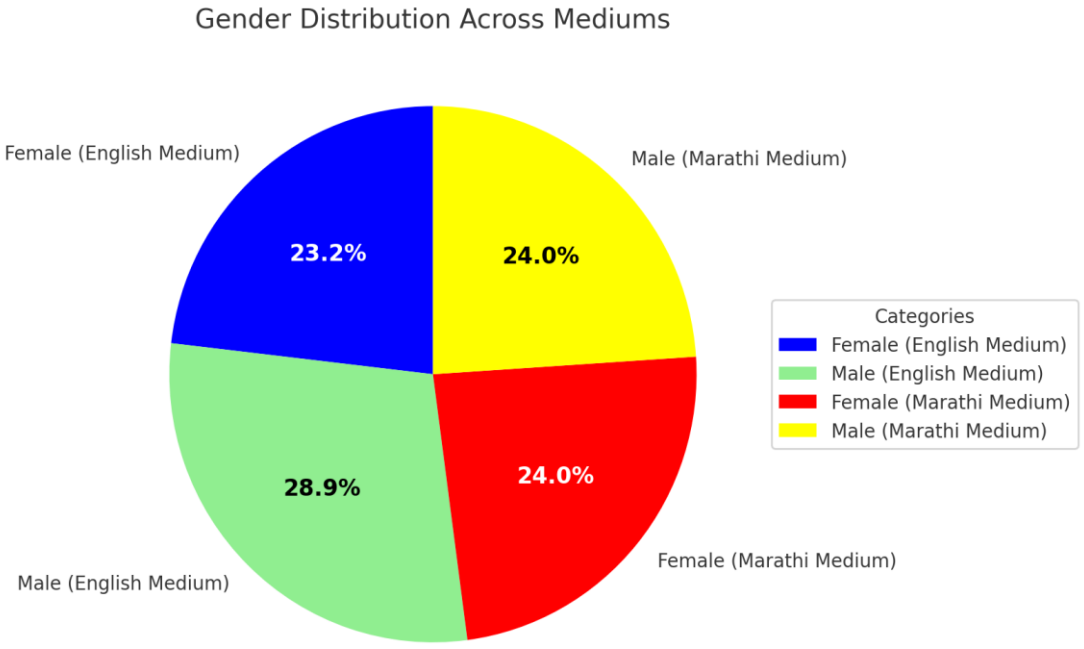


Chart 1



14. Statistical tools

The data collected by using the Baquer Mehdi non verbal test was analysed and interpreted through various statistical techniques.

For the current research researcher has selected Percentage, Mean, Standard deviation, T-test, ANOVA as statistical techniques.

15. Methodology

The researcher wanted to do a comparative study of non-verbal creative thinking ability amongst IXth grade students studying in English and Marathi Medium of Aurangabad. The subject of comparing non-verbal creative thinking ability among students in Aurangabad city was particularly significant.

After determining the problem, a comprehensive research plan was prepared. This plan outlined the need for research, objectives, assumptions, hypotheses, population, sample selection methods, research methods, research tools, use of statistical techniques, and cost estimates. The preparation of the research plan helped to provide a clear direction for the research work.

Six hundred and twenty two students from Aurangabad city were selected for the research using a random sampling method. The data was collected from the participants through a questionnaire to obtain the necessary information for the study. Subsequently, tables were created from this data, and its significance was interpreted, leading to the drawn conclusions.

Variables:

Dependent Variable: Non-verbal creativity score if the student

Independent Variables: Gender and Medium of Instruction.

Data Collection:

A self-reporting data collection sheet was provided to each student. The sheet includes information such as age, gender, mother tongue, and medium of instruction (English or Marathi). Some additional variables were also collected like favourite color, blood group, diet preference veg or non-veg. The Baquer Mehdi figural creativity test was administered to each participant to measure their non-verbal creative thinking ability.

Data Analysis:

The non-verbal creativity score for each participant was calculated based on their performance on the Baquer Mehdi figural creativity test. Descriptive statistics such as mean and standard deviation used to summarize the data. The t-test used to compare the non-verbal creativity scores of students in English and Marathi medium schools.

The raw scores are converted into T-score, the t-score, also known as the Student's t-score or t-value, is a measure that indicates how many standard deviations an observed sample mean is away from the hypothetical population mean when the sample follows a Student's t-distribution.

The t-score is commonly used in hypothesis testing, especially when the sample size is small or when the population standard deviation is unknown. It helps determine if the difference between the sample mean and the hypothesized population mean is statistically significant.

Total Creativity (T-Score) = Elaboration(E-Score) + Originality (O-Score)

Where T-Score, E-Score and O-Score are computed using the formula:

$T = (10/SD) * (X - M) + 50$

SD= Standard deviation of Sample

M = Mean

X = Raw score

16. Procedure

For the current research the researcher selected 622 students as samples from various state schools of Aurangabad city. The researcher has used random sampling techniques for his research. Before data collection, proper permissions were obtained from the principals of the selected schools. Data collection was conducted in a controlled and standardized environment to minimize potential sources of bias.

This research adhered to ethical guidelines, including informed consent, confidentiality, and the protection of participants' rights and welfare. written approval for the study was sought from the relevant institutional heads.

The data collected is analysed and interpreted by using various tools of statistics like mean, t-score, percentage, standard deviation. Researcher has arranged information in proper table as well as graphs has been used to access the numerical data easily, observation and interpretation is also mentioned below the table. Main finding of the research is mentioned in the fifth chapter of the research report.

17. Pilot Study

A pilot study is a primary trial of research which is essential to the development of an extensive research. In a pilot study the whole research is carried out but with fewer participants that would be used for an extensive research. In addition to achieving all the objectives of the usual tryout, such as improving data collection methods, and checking the appropriateness of standard measures, the pilot study provides additional knowledge that leads to improved research. The pilot study greatly reduces the number of treatment errors because unseen problems raised in the study may be overcome in redesigning the implementation or the research itself.

The Pilot study was conducted on 30 students as per sample distribution criteria from various schools which were intended to decide the appropriateness of sample, tests used, coding method and the statistical procedures that were used for final study.

18. Main findings

I) Analysis of the variables of non verbal creativity based on medium of Instruction (English and Marathi)

Table 2

Variable	Comparison	Mean (English)	Mean (Marathi)
T-Score	English medium and Marathi medium	49.46	50.41
E-Score	English medium and Marathi medium	49.44	50.56
O-Score	English medium and Marathi medium	56.05	57.23

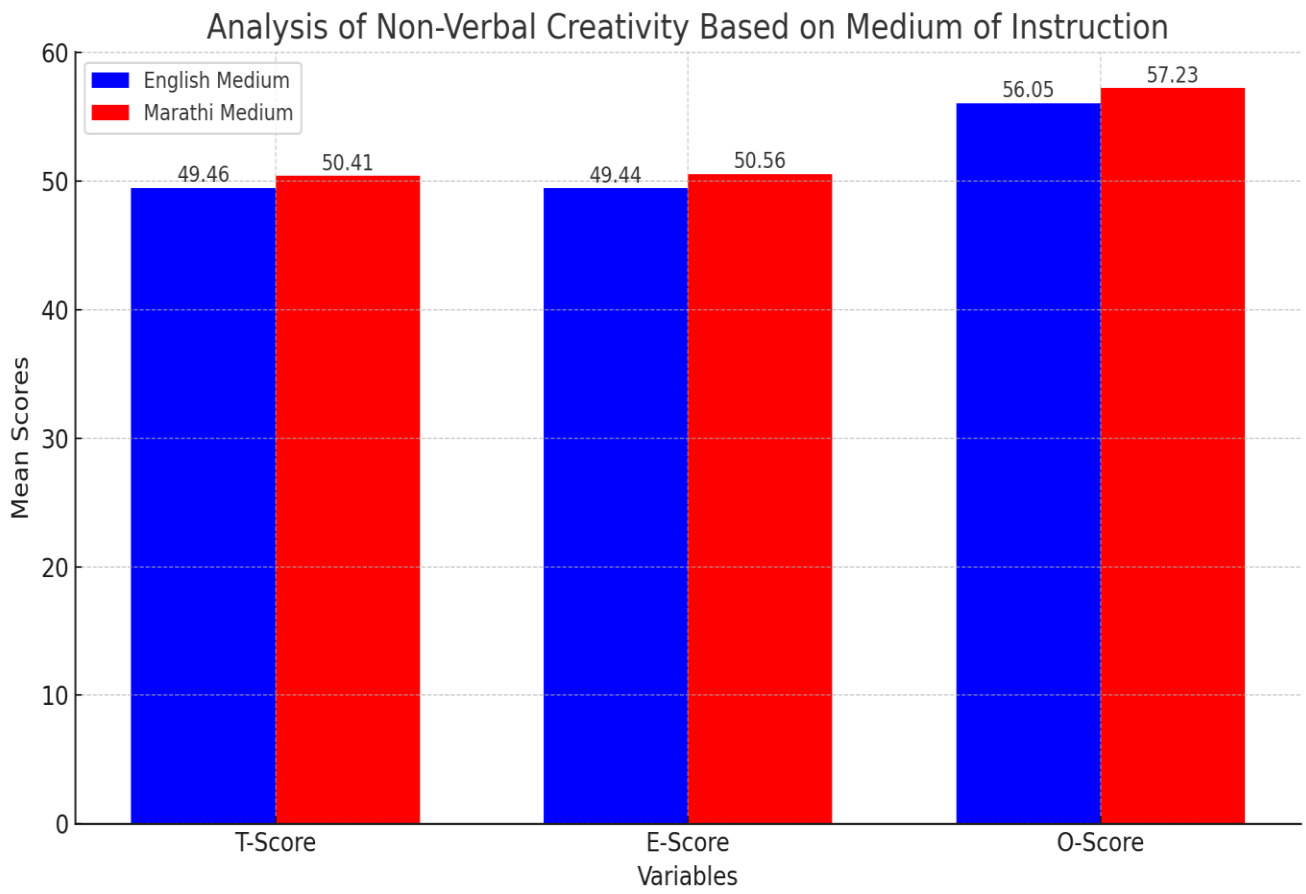
Observation

1. The mean of Total score of English medium school is 49.46
2. The mean of Total score of Marathi medium school is 50.41
3. The mean of Elaboration score of English medium school is 49.44
4. The mean of Elaboration score of Marathi medium school is 50.56
5. The mean of Originality score of English medium school is 56.05
6. The mean of Originality score of Marathi medium school is 57.23

Interpretation

1. The mean of the Total score of Marathi medium school is higher than English medium school.
2. The mean of the Elaboration score of Marathi medium school is higher than English medium school.
3. The mean of the Originality score of Marathi medium school is higher than English medium school.

Graph 2


Analysis of Non-Verbal Creativity Based on Medium of Instruction
English Medium
Marathi Medium
Mean Scores
Variables
T-Score
E-Score
O-Score
49.46
50.41
49.44
50.56
56.05
57.23
0
10
20
30
40
50
60

II) Analysis of the variables of non verbal creativity based on gender (Males and Females)

Table : 3

Variable	Comparison	Mean (Males)	Mean (Females)
T-Score	Males and Females	47.872	51.457
E-Score	Males and Females	45.851	49.362
O-Score	Males and Females	50.383	53.761

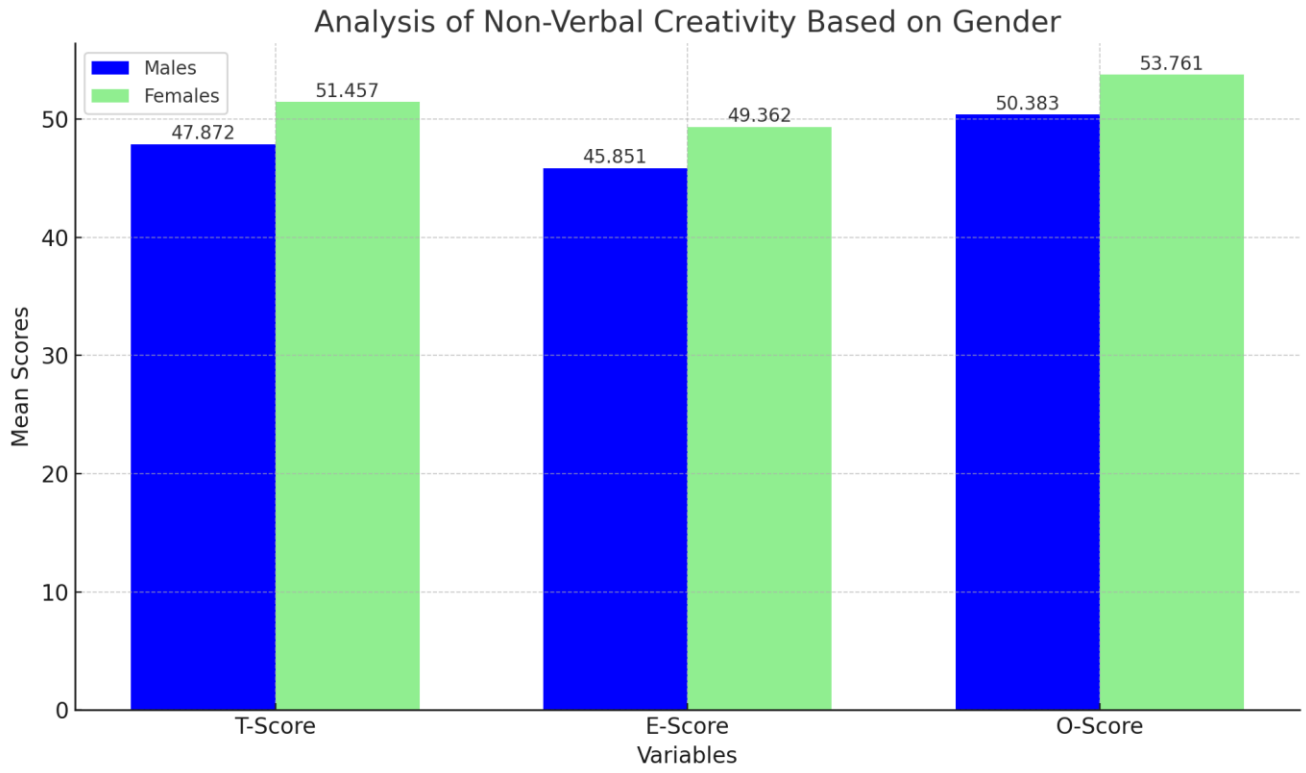
Observation

1. The mean of Total score of Males is 47.872
2. The mean of Total score of Females is 51.457
3. The mean of Elaboration score of Males is 45.851
4. The mean of Elaboration score of of Females is 49.362
5. The mean of Originality score of Males is 50.383
6. The mean of Originality score of Females is 53.761

Interpretation

1. The mean Total score of Females is higher than Males.
2. The mean Elaboration score of Females is higher than Males.
3. The mean Originality score of Females is higher than Males.

Graph 3


Analysis of Non-Verbal Creativity Based on Gender
Males
Females
47.872
51.457
45.851
49.362
50.383
53.761
Mean Scores
0
10
20
30
40
50
T-Score
E-Score
O-Score
Variables

III) Analysis of the T-Score variable of non verbal creativity based on Medium and Gender

Table 4

Variable	Comparison	Mean (Group 1)	Mean (Group 2)
T-Score	English Medium Males and Marathi Medium Females	47.62	48.42
T-Score	EnglishMedium Females and Marathi Medium Females	50.87	51.62
T-Score	English Medium Males and English Medium Females	47.62	50.87
T-Score	Marathi Medium Males and Marathi Medium Females	48.42	51.62

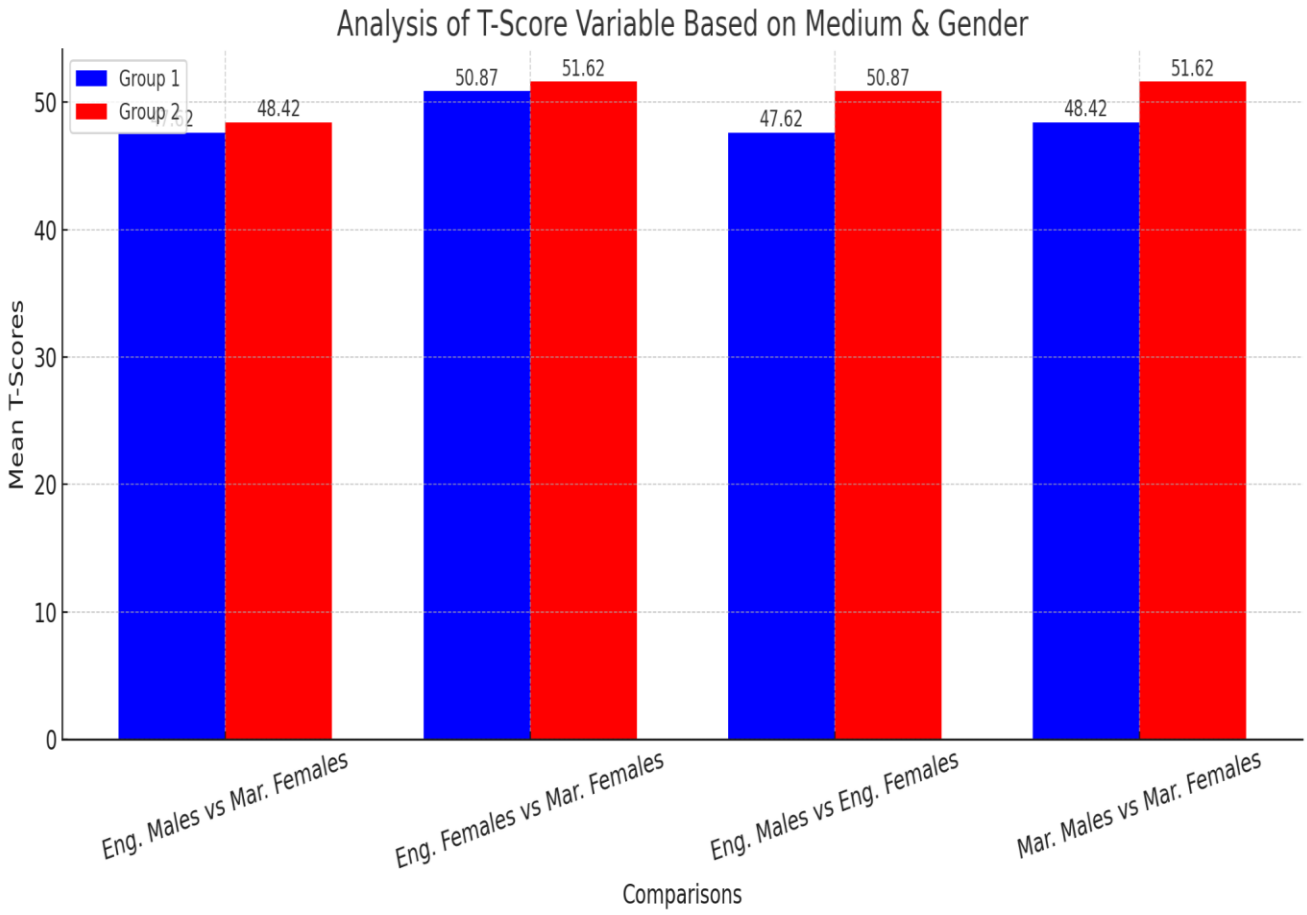
Observation

1. The mean Total score of English medium Males is 47.62.
2. The mean Total score of Marathi medium Females is 48.42.
3. The mean Total score of English medium Females is 50.87.
4. The mean Total score of Marathi medium Females is 51.62.
5. The mean Total score of English medium Males is 47.62.
6. The mean Total score of English medium Females is 50.87.
7. The mean Total score of Marathi medium Males is 48.42.
8. The mean Total score of Marathi medium Females is 51.62.

Interpretation

1. The mean Total score of Marathi medium Females (51.62) is higher than English medium Females (50.87).
2. The mean Total score of English medium Females (50.87) is higher than Marathi medium Males (48.42).
3. The mean Total score of Marathi medium Males (48.42) is higher than English medium Males (47.62).
4. The mean Total score of Marathi medium Females (51.62) is higher than English medium Males (47.62).

Graph 4


Analysis of T-Score Variable Based on Medium & Gender
Group 1
Group 2
Mean T-Scores
0
10
20
30
40
50
48.42
50.87
51.62
47.62
50.87
48.42
51.62
Eng. Males vs Mar. Females
Eng. Females vs Mar. Females
Eng. Males vs Eng. Females
Mar. Males vs Mar. Females
Comparisons

IV) Analysis of the E-Score variable of non verbal creativity based on Medium and Gender

Table 5

Variable	Comparison	Mean (Group 1)	Mean (Group 2)
E-Score	English Medium Males and Marathi Medium Males	45.62	46.71
E-Score	English Medium Females and Marathi Medium Females	47.86	48.71
E-Score	English Medium Males and English Medium Females	45.62	47.86
E-Score	Marathi Medium Males and Marathi Medium Females	46.71	48.71

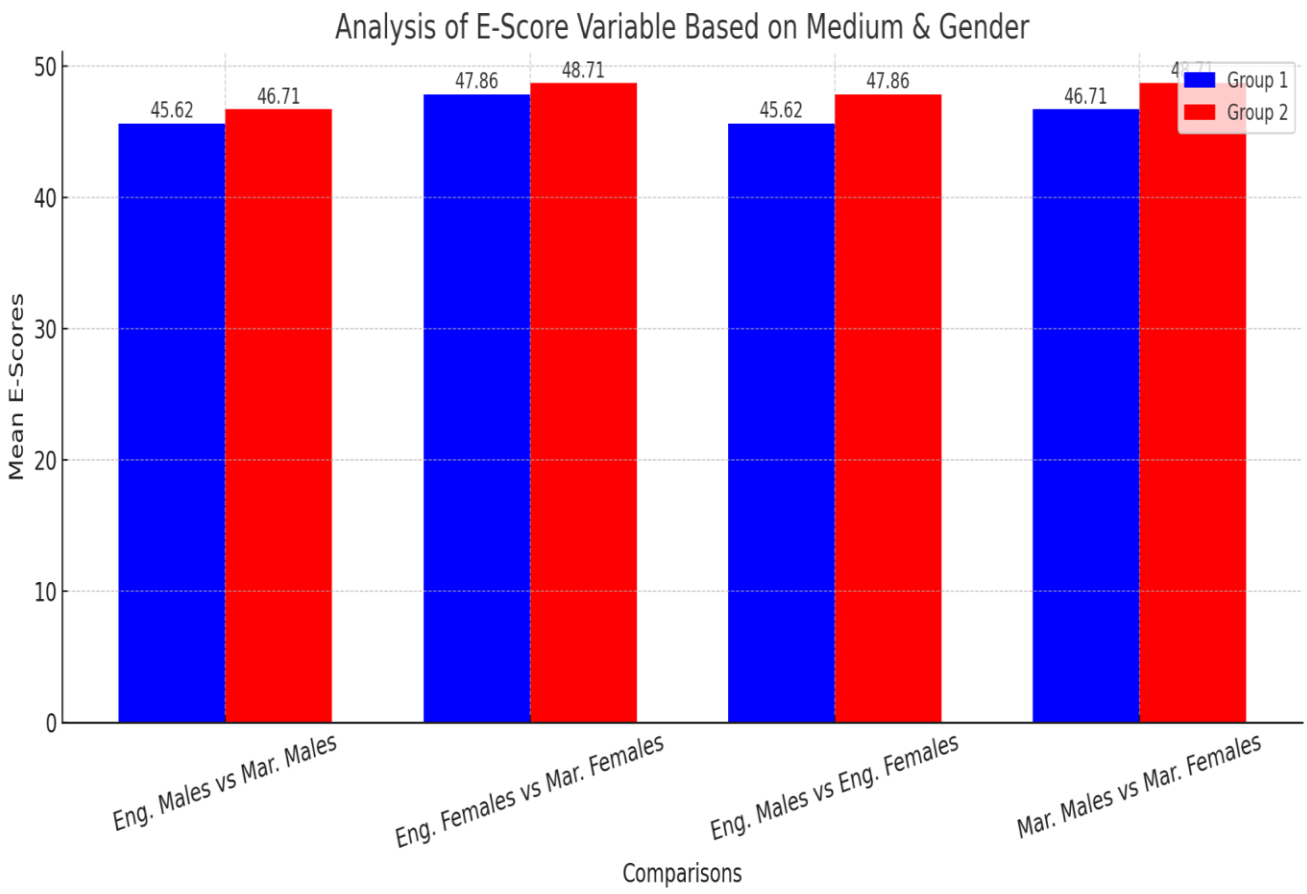
Observation

1. The mean of E-Score for English medium Males is 45.62.
2. The mean of E-Score for Marathi medium Males is 46.71.
3. The mean of E-Score for English medium Females is 47.86.
4. The mean of E-Score for Marathi medium Females is 48.71.
5. The mean of E-Score for English medium Males is 45.62.
6. The mean of E-Score for English medium Females is 47.86.
7. The mean of E-Score for Marathi medium Males is 46.71.
8. The mean of E-Score for Marathi medium Females is 48.71.

Interpretation

1. The mean E-Score of Marathi medium Females (48.71) is higher than English medium Females (47.86).
2. The mean E-Score of English medium Females (47.86) is higher than Marathi medium Males (46.71).
3. The mean E-Score of Marathi medium Males (46.71) is higher than English medium Males (45.62).
4. The mean E-Score of Marathi medium Females (48.71) is higher than English medium Males (45.62).

Graph 5


Analysis of E-Score Variable Based on Medium & Gender
Mean E-Scores
Comparisons
Group 1
Group 2
45.62
46.71
47.86
48.71
45.62
47.86
46.71
Eng. Males vs Mar. Males
Eng. Females vs Mar. Females
Eng. Males vs Eng. Females
Mar. Males vs Mar. Females
0
10
20
30
40
50

V) Analysis of the O-Score variable of non verbal creativity based on Medium and Gender

Table 6

Variable	Comparison	Mean (Group 1)	Mean (Group 2)
O-Score	English Medium Males and Marathi Medium Males	52.05	53.11
O-Score	English Medium Females and Marathi Medium Females	55.67	56.88
O-Score	English Medium Males and English Medium Females	52.05	55.67
O-Score	Marathi Medium Males and Marathi Medium Females	53.11	56.88

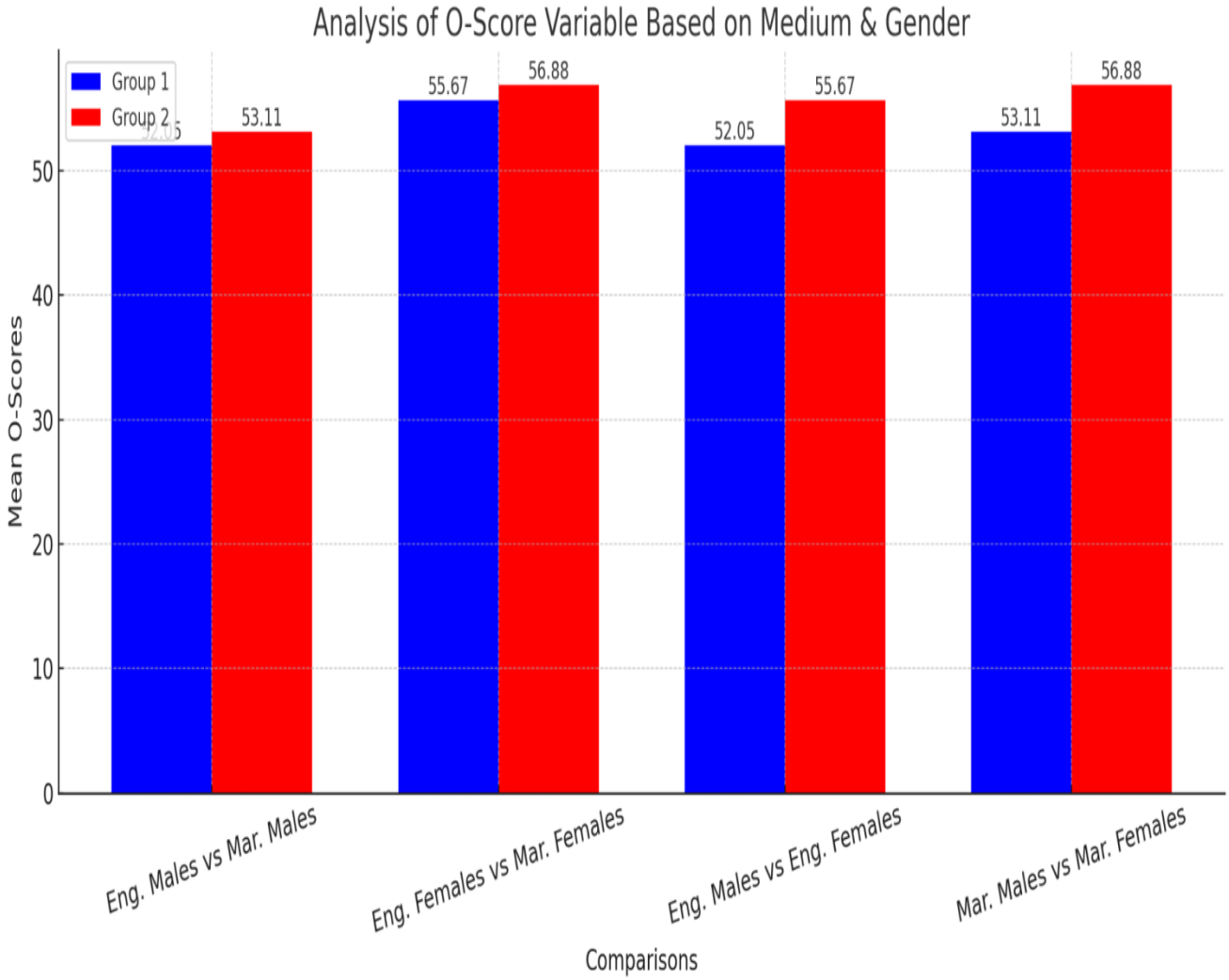
Observation

1. The mean of O-Score for English medium Males is 52.05.
2. The mean of O-Score for Marathi medium Males is 53.11.
3. The mean of O-Score for English medium Females is 55.67.
4. The mean of O-Score for Marathi medium Females is 56.88.
5. The mean of O-Score for English medium Males is 52.05.
6. The mean of O-Score for English medium Females is 55.67.
7. The mean of O-Score for Marathi medium Males is 53.11.
8. The mean of O-Score for Marathi medium Females is 56.88.

Interpretation

1. The mean O-Score of Marathi medium Females (56.88) is higher than English medium Females (55.67).
2. The mean O-Score of English medium Females (55.67) is higher than Marathi medium Males (53.11).
3. The mean O-Score of Marathi medium Males (53.11) is higher than English medium Males (52.05).
4. The mean O-Score of Marathi medium Females (56.88) is higher than English medium Males (52.05).

Graph 6


Analysis of O-Score Variable Based on Medium & Gender
Group 1
Group 2
Mean O-Scores
0
10
20
30
40
50
52.05
53.11
55.67
56.88
52.05
55.67
53.11
56.88
Eng. Males vs Mar. Males
Eng. Females vs Mar. Females
Eng. Males vs Eng. Females
Mar. Males vs Mar. Females
Comparisons

VI) Analysis of level of significance of non verbal creativity variables based on medium of Instruction (English and Marathi)

Table 7

Variable	Medium	Numbers	Mean	S.D	df	Critical value	t-Value	p-Value	Level of Significance
T-Score	English	324	49.45	10.71	323	± 1.96	-1.45	0.15	Not Significant
T-Score	Marathi	298	50.6	9.15	297	± 1.96	-1.45	0.15	Not Significant
E-Score	English	324	47.48	9.56	323	± 1.96	-0.95	0.34	Not Significant
E-Score	Marathi	298	48.16	8.44	297	± 1.96	-0.95	0.34	Not Significant
O-Score	English	324	51.68	11.71	323	± 1.96	-1.78	0.08	Not Significant
O-Score	Marathi	298	53.25	10.27	297	± 1.96	-1.78	0.08	Not Significant

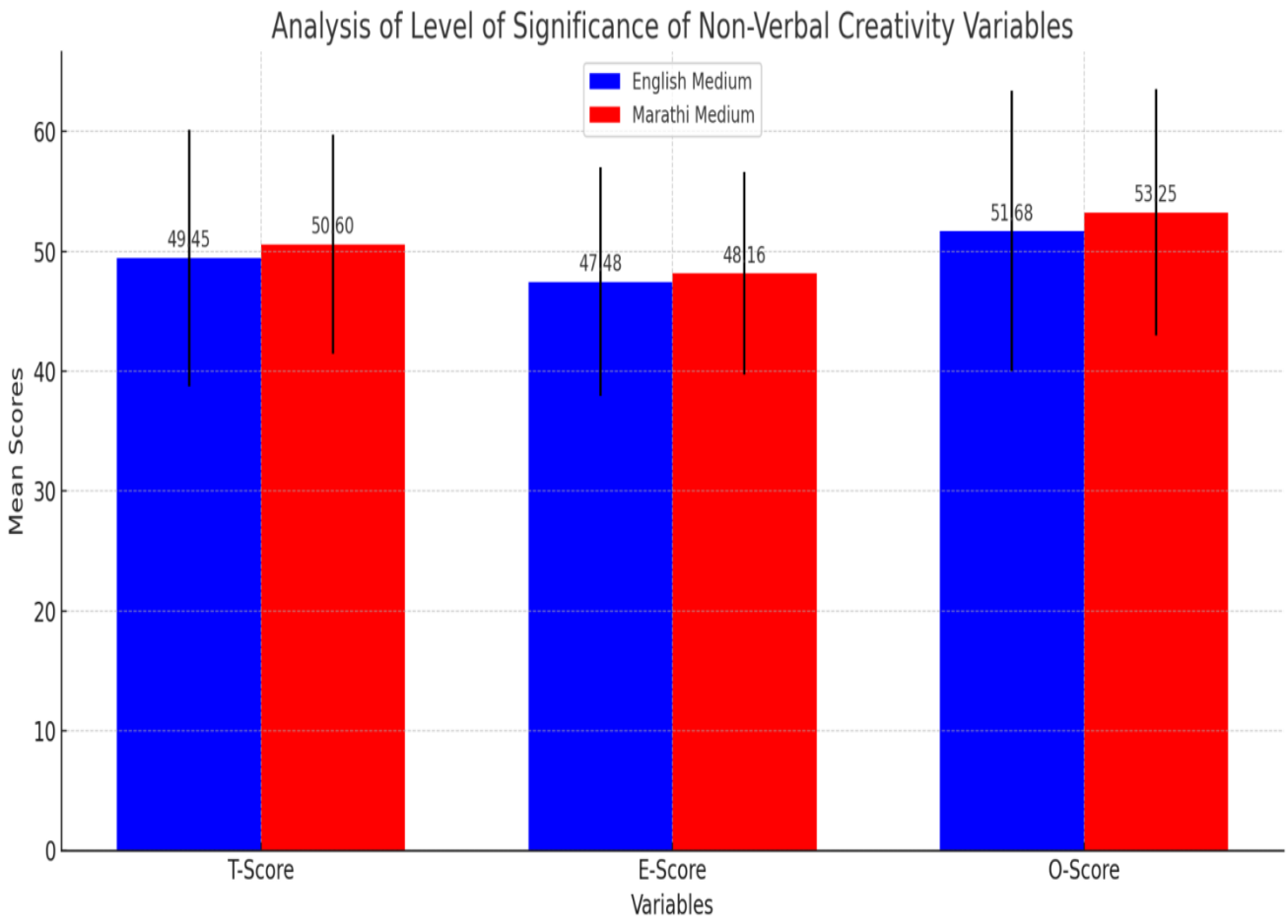
Observation

1. The mean T-Score of English medium students is 49.45, with a standard deviation of 10.71.
2. The mean T-Score of Marathi medium students is 50.60, with a standard deviation of 9.15.
3. The t-value for T-Score is -1.45, and the p-value is 0.15, which is greater than the critical threshold of 0.05.
4. The mean E-Score of English medium students is 47.48, with a standard deviation of 9.56.
5. The mean E-Score of Marathi medium students is 48.16, with a standard deviation of 8.44.
6. The t-value for E-Score is -0.95, and the p-value is 0.34, which is greater than the critical threshold of 0.05.
7. The mean O-Score of English medium students is 51.68, with a standard deviation of 11.71.
8. The mean O-Score of Marathi medium students is 53.25, with a standard deviation of 10.27.
9. The t-value for O-Score is -1.78, and the p-value is 0.08, which is greater than the critical threshold of 0.05.

Interpretation

1. The difference in T-Score between English and Marathi medium students is not statistically significant.
2. The difference in E-Score between English and Marathi medium students is not statistically significant.
3. The difference in O-Score between English and Marathi medium students is not statistically significant.

Graph 7


Analysis of Level of Significance of Non-Verbal Creativity Variables
English Medium
Marathi Medium
Mean Scores
0
10
20
30
40
50
60
49.45
50.60
47.48
48.16
51.68
53.25
T-Score
E-Score
O-Score
Variables

VII) Analysis of level of significance of non verbal creativity variables based on Gender (Males and Females)

Table 8

Variable	Gender	Numbers	Mean	S.D	df	Critical value	t-Value	p-Value	Level of Significance
T-Score	Male	329	48.31	9.87	328	± 1.96	-4.54	0	Significant
T-Score	Female	293	51.9	9.82	292	± 1.96	-4.54	0	Significant
E-Score	Male	329	46.15	8.83	328	± 1.96	-4.94	0	Significant
E-Score	Female	293	49.67	8.91	292	± 1.96	-4.94	0	Significant
O-Score	Male	329	50.84	11.03	328	± 1.96	-3.84	0	Significant
O-Score	Female	293	54.21	10.85	292	± 1.96	-3.84	0	Significant

Observations:

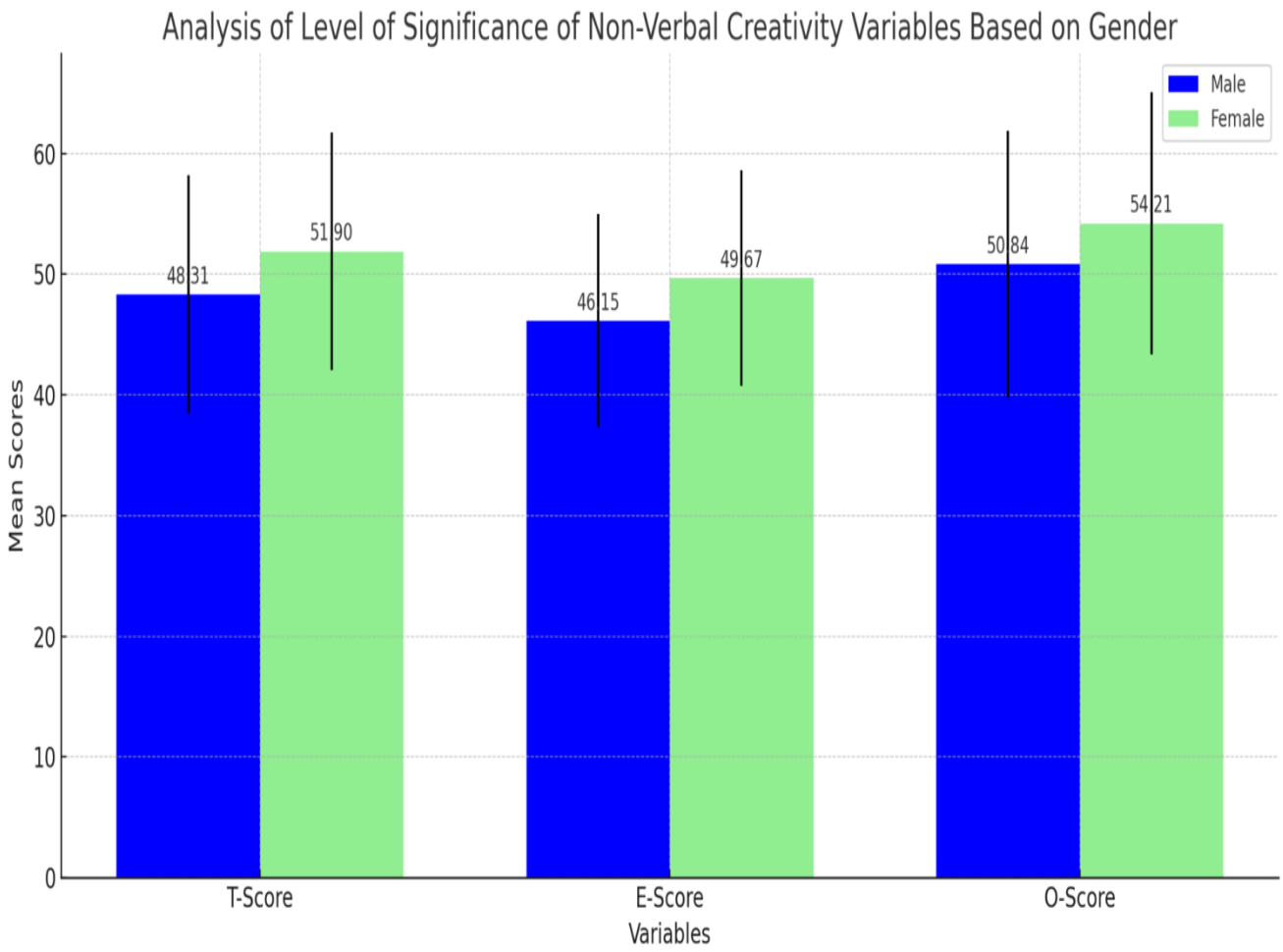
1. The mean T-Score for males is 48.31, while for females it is 51.90, showing that females score higher on average.
2. The standard deviation for males is 9.87, slightly higher than for females (9.82), indicating more variability in male scores.
3. The t-value is -4.54, with a p-value of 0.00, indicating a statistically significant difference in T-Scores between males and females.

4. The mean E-Score for males is 46.15, while for females it is 49.67, again showing higher scores for females.
5. The standard deviation for males is 8.83, slightly lower than for females (8.91), indicating less variability in male scores.
6. The t-value is -4.94, with a p-value of 0.00, demonstrating a statistically significant difference in E-Scores between genders.
7. The mean O-Score for males is 50.84, while for females it is 54.21, indicating females perform better in originality.
8. The standard deviation for males is 11.03, slightly higher than for females (10.85), showing more variability in male scores.
9. The t-value is -3.84, with a p-value of 0.00, confirming a statistically significant difference in O-Scores between genders.

Interpretation:

1. **Overall Gender Differences in Verbal Creativity:**
   The observations reveal consistent and statistically significant differences in verbal creativity variables (T-Score, E-Score, and O-Score) between males and females. **In all three dimensions, females outperform males on average.**
2. **T-Score Interpretation:**
   - The higher mean T-Score for females (51.90) compared to males (48.31) suggests that females exhibit stronger overall verbal creativity.
   - The slightly higher variability (S.D of 9.87) in male scores indicates that males have a broader range of abilities within the group.
   - The statistically significant t-value (-4.54) and p-value (0.00) confirm that the observed difference in T-Scores is unlikely to be due to chance.
3. **E-Score Interpretation:**
   - Females achieve a higher mean E-Score (49.67) than males (46.15), indicating that females are better at elaboration in verbal creativity tasks.
   - The variability in E-Scores is slightly greater for females (S.D of 8.91) compared to males (8.83), suggesting a wider range of elaboration abilities in females.
   - The statistically significant t-value (-4.94) and p-value (0.00) reinforce that gender differences in E-Scores are meaningful.
4. **O-Score Interpretation:**
   - Females have a higher mean O-Score (54.21) compared to males (50.84), reflecting stronger originality in verbal creativity tasks.
   - Males exhibit greater variability in originality (S.D of 11.03) than females (10.85), indicating a more diverse range of originality abilities in males.
   - The t-value (-3.84) and p-value (0.00) confirm a statistically significant gender difference in O-Scores.
5. **Consistency Across Variables:**
   - The consistent higher performance of females across all three variables highlights a gender-related advantage in verbal creativity.
   - The statistically significant results (p-value 0.00 for all variables) suggest that these differences are robust and not due to random variation.

Graph 8


Analysis of Level of Significance of Non-Verbal Creativity Variables Based on Gender
Male
Female
Mean Scores
0
10
20
30
40
50
60
48.31
51.90
46.15
49.67
50.84
54.21
T-Score
E-Score
O-Score
Variables

VII) Analysis of level of significance of T - Score component based on Medium (English and Marathi) and Gender (Males and Females)

ANOVA table for T - Score component

Table 9

Source	Sum of Squares (SS)	Degrees of Freedom (df)	F-statistic (F)	p-value (PR(>F))	Significant
Gender	1936.36	1	19.96	0.000009	Yes
Medium	141.02	1	1.45	0.228	No
Gender × Medium	16.99	1	0.18	0.676	No
Residual	59940.76	618			

Observations:

1. Gender:
    - The sum of squares (SS) is 1936.35.
    - The F-statistic is 19.96, with a p-value of 0.000009 ($p < 0.05$).
    - The result is statistically significant, indicating a notable difference in T-Scores between genders.
2. Medium (English vs. Marathi):
    - The sum of squares (SS) is 141.021.
    - The F-statistic is 1.454, with a p-value of 0.228357 ($p > 0.05$).
    - The result is not statistically significant, suggesting no substantial difference in T-Scores based on medium of instruction.
3. Interaction between Gender and Medium:
    - The sum of squares (SS) is 16.990.
    - The F-statistic is 0.175, with a p-value of 0.675706 ($p > 0.05$).
    - The interaction effect is not statistically significant, indicating a negligible combined effect of gender and medium on T-Scores.
4. Residual:
    - The sum of squares (SS) is 59940.755, and the degrees of freedom (df) are 618.
    - A large proportion of the variability in T-Scores remains unexplained by the tested factors (gender, medium, and their interaction).

Interpretation:

Gender:

- Gender has a significant impact on T-Scores. This indicates inherent differences in T-Scores between males and females that are unlikely to occur by chance.

Medium (English vs. Marathi):

- The medium of instruction does not have a significant influence on T-Scores. This suggests that T-Scores are similar regardless of whether the medium is English or Marathi.

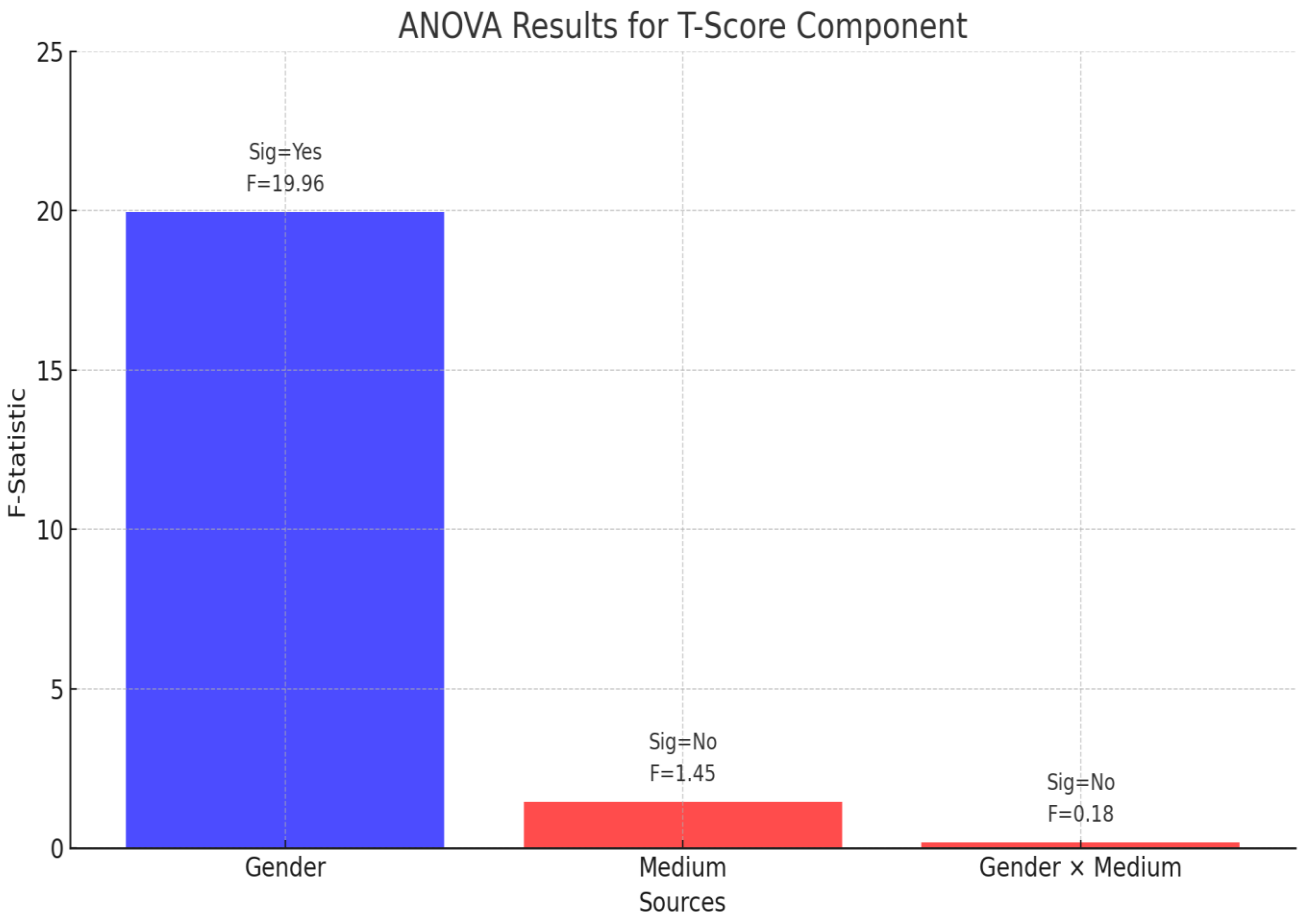
Interaction between Gender and Medium:

- The interaction between gender and medium does not significantly affect T-Scores. This implies that the relationship between gender and T-Scores remains consistent across the two mediums.

Residual:

- A considerable portion of variability in T-Scores is not accounted for by the factors analyzed, indicating the need to explore additional variables or influences that might explain the remaining variance.

Graph 9



IIX) Analysis of level of significance of E- Score component based on Medium (English and Marathi) and Gender (Males and Females)

ANOVA table for E - Score component

Table 10

Source	Sum of Squares (SS)	Degrees of Freedom (df)	F-statistic (F)	p-value (PR(>F))	Significant
Gender	1885.31	1	23.9	0.000001	Yes
Medium	37.05	1	0.47	0.493	No
Gender × Medium	3.1	1	0.04	0.843	No
Residual	48760.05	618			

Observation

1. Gender:
    - Sum of Squares (SS): 1885.31
    - F-statistic (F): 23.90
    - p-value: 0.000001 ($p < 0.05$)
    - Observation: The result is highly significant, indicating a notable difference in E-Scores between genders.
2. Medium (English vs. Marathi):
    - Sum of Squares (SS): 37.05
    - F-statistic (F): 0.47
    - p-value: 0.493 ($p > 0.05$)
    - Observation: The result is not statistically significant, suggesting no substantial difference in E-Scores based on the medium of instruction.
3. Interaction between Gender and Medium:
    - Sum of Squares (SS): 3.10
    - F-statistic (F): 0.04
    - p-value: 0.843 ($p > 0.05$)
    - Observation: The interaction effect is not significant, indicating a negligible combined effect of gender and medium on E-Scores.
4. Residual:
    - Sum of Squares (SS): 48760.05
    - Degrees of Freedom (df): 618
    - Observation: A large proportion of variability in E-Scores is not explained by the tested factors.

Interpretation:

Gender:

- Gender has a significant impact on E-Scores. This indicates inherent differences in E-Scores between males and females that are unlikely to occur by chance.

Medium (English vs. Marathi):

- The medium of instruction does not have a significant influence on E-Scores. This suggests that E-Scores are similar regardless of whether the medium is English or Marathi.

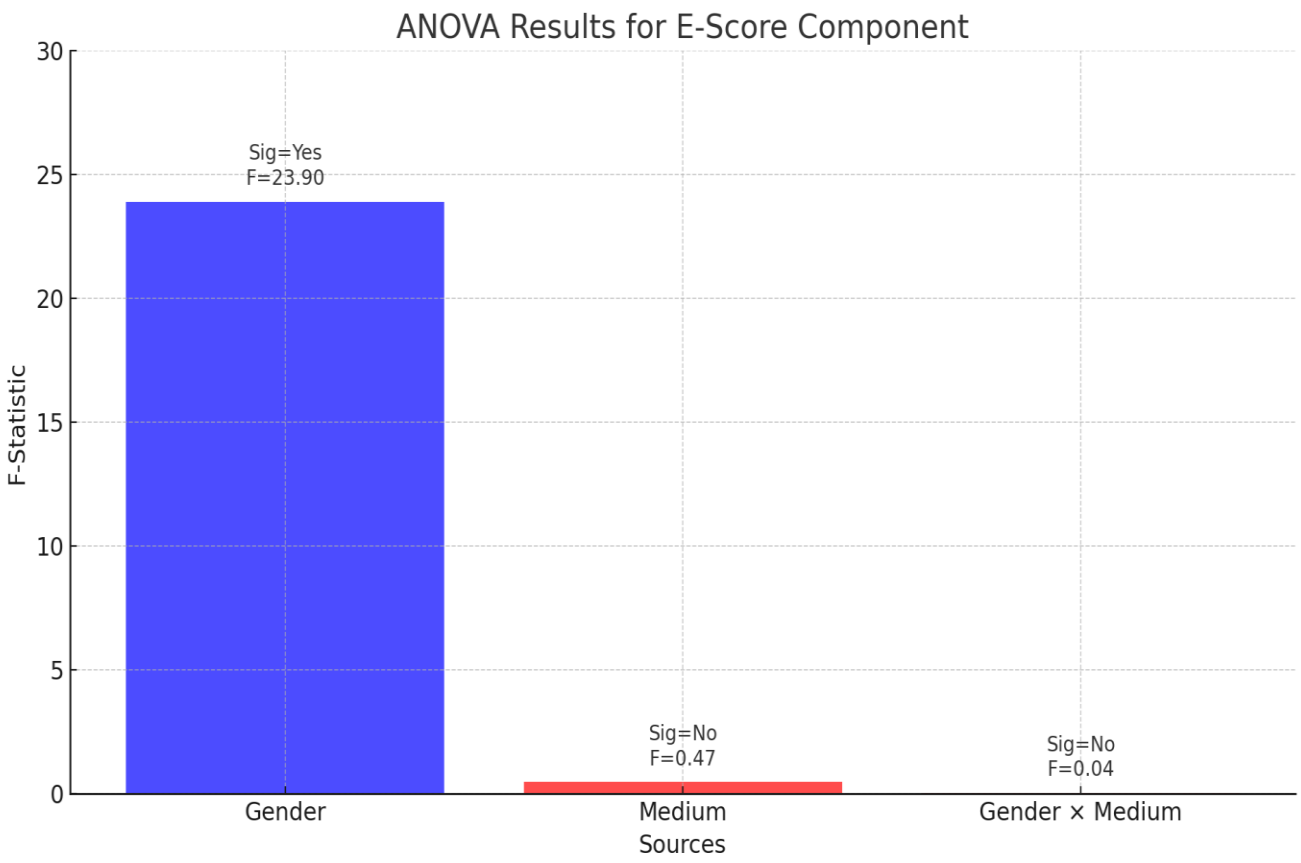
Interaction between Gender and Medium:

- The interaction between gender and medium does not significantly affect E-Scores. This implies that the relationship between gender and E-Scores remains consistent across the two mediums.

Residual:

- A considerable portion of variability in E-Scores is not accounted for by the factors analyzed, suggesting the need to explore additional variables or influences.

Graph 10



IX) Analysis of level of significance of O- Score component based on Medium (English and Marathi) and Gender (Males and Females)

ANOVA table for O - Score component

Table 11

Source	Sum of Squares (SS)	Degrees of Freedom (df)	F-statistic (F)	p-value (PR(>F))	Significant
Gender	1673.94	1	13.99	0	Yes
Medium	298.37	1	2.49	0.115	No
Gender × Medium	40.76	1	0.34	0.56	No
Residual	73932.07	618			

Observations

Gender:

- Sum of Squares (SS): 1673.94
- F-statistic (F): 13.99
- p-value: 0.000 ($p < 0.05$)
- Observation: The result is highly significant, indicating a strong difference in O-Scores based on gender.

Medium (English vs. Marathi):

- Sum of Squares (SS): 298.37
- F-statistic (F): 2.49
- p-value: 0.115 ($p > 0.05$)
- Observation: The result is not statistically significant, suggesting no substantial difference in O-Scores based on medium of instruction.

Interaction between Gender and Medium:

- Sum of Squares (SS): 40.76
- F-statistic (F): 0.34
- p-value: 0.560 ($p > 0.05$)
- Observation: The interaction effect is not significant, indicating a negligible combined effect of gender and medium on O-Scores.

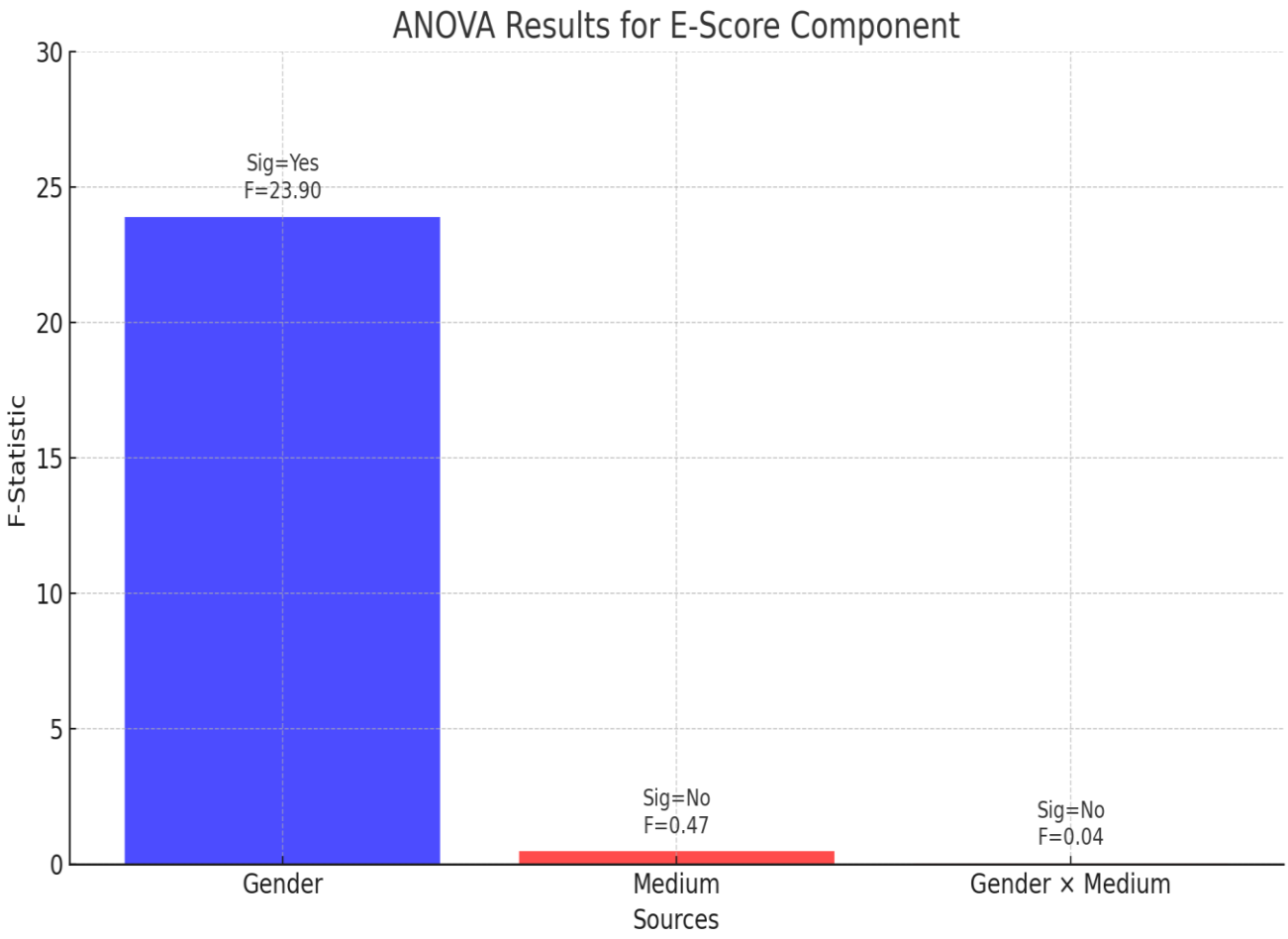
Residual:

- Sum of Squares (SS): 73932.07
- Degrees of Freedom (df): 618
- Observation: A large proportion of variability in O-Scores is not explained by the tested factors.

Interpretation:

- Gender:
  - Gender has a significant impact on O-Scores. This indicates inherent differences in O-Scores between males and females that are unlikely to occur by chance.
- Medium (English vs. Marathi):
  - The medium of instruction does not significantly influence O-Scores. This suggests that O-Scores are similar regardless of whether the medium is English or Marathi.
- Interaction between Gender and Medium:
  - The interaction between gender and medium does not significantly affect O-Scores. This implies that the relationship between gender and O-Scores remains consistent across the two mediums.
- Residual:
  - A considerable portion of variability in O-Scores is not accounted for by the factors analyzed, suggesting the need to explore additional variables or influences.

Graph 11



Hypothesis Testing Results, Based on T-Test and ANOVA:

1. T-Score: Medium (English vs. Marathi)

- Null Hypothesis: There is no significant difference in Total Creativity Scores (T-Score) between students instructed in Marathi and those instructed in English.
- Alternative Hypothesis: There is a significant difference in T-Score between students instructed in Marathi and those instructed in English.

Result:

- t-statistic: -1.45
- p-value: 0.149

Decision: Fail to reject the null hypothesis.
Conclusion: The null hypothesis is accepted.

There is no significant difference in T-Scores between students instructed in English and Marathi.

2. E-Score: Medium (English vs. Marathi)

- Null Hypothesis: There is no significant difference in E-Score between students instructed in Marathi and those instructed in English.
- Alternative Hypothesis: There is a significant difference in E-Score between students instructed in Marathi and those instructed in English.

Result:

- t-statistic: -0.95
- p-value: 0.344

Decision: Fail to reject the null hypothesis.
Conclusion: The null hypothesis is accepted.
There is no significant difference in E-Scores between students instructed in English and Marathi.

3**. O-Score: Medium (English vs. Marathi)**

- Null Hypothesis: There is no significant difference in O-Score between students instructed in Marathi and those instructed in English.
- Alternative Hypothesis: There is a significant difference in O-Score between students instructed in Marathi and those instructed in English.

Result:

- t-statistic: -1.78
- p-value: 0.075

Decision: Fail to reject the null hypothesis.
Conclusion: The null hypothesis is accepted.
There is no significant difference in O-Scores between students instructed in English and Marathi.

4. T-Score: Gender (Male vs. Female)

- Null Hypothesis: There is no significant difference in Total Creativity Scores (T-Score) between males and females.
- Alternative Hypothesis: There is a significant difference in T-Score between males and females.

Result:

- t-statistic: -4.54
- p-value: 0.000007

Decision: Reject the null hypothesis.
Conclusion: The null hypothesis is rejected.
There is a significant difference in T-Scores between males and females

5. E-Score: Gender (Male vs. Female)

- Null Hypothesis: There is no significant difference in E-Score between males and females.
- Alternative Hypothesis: There is a significant difference in E-Score between males and females.

Result:

- t-statistic: -4.94
- p-value: 0.000001

Decision: Reject the null hypothesis.
Conclusion: The null hypothesis is rejected.
There is a significant difference in E-Scores between males and females

6**. O-Score: Gender (Male vs. Female)**

- Null Hypothesis: There is no significant difference in O-Score between males and females.
- Alternative Hypothesis: There is a significant difference in O-Score between males and females.

Result:

- t-statistic: -3.84
- p-value: 0.000138

Decision: Reject the null hypothesis.
Conclusion: The null hypothesis is rejected.

There is a significant difference in O-Scores between males and females.

Hypothesis Testing Results Table

Table 12

	Hypothesis	Accepted Null or Alternate	t-Statistic	p-Value	Decision	Conclusion
1	There is no significant difference in T-Score between students instructed in Marathi and English.	Null	-1.45	0.149	Fail to reject null	Null hypothesis is accepted: No significant difference in T-Scores based on medium.
2	There is no significant difference in E-Score between students instructed in Marathi and English.	Null	-0.95	0.344	Fail to reject null	Null hypothesis is accepted: No significant difference in E-Scores based on medium.
3	There is no significant difference in O-Score between students instructed in Marathi and English.	Null	-1.78	0.075	Fail to reject null	Null hypothesis is accepted: No significant difference in O-Scores based on medium.
4	There is no significant difference in T-Score between males and females.	Alternate	-4.54	0.000007	Reject null	Null hypothesis is rejected: Significant difference in T-Scores, females scored higher.
5	There is no significant difference in E-Score between males and females.	Alternate	-4.94	0.000001	Reject null	Null hypothesis is rejected: Significant difference in E-Scores, females scored higher.
6	There is no significant difference in O-Score between males and females.	Alternate	-3.84	0.000138	Reject null	Null hypothesis is rejected: Significant difference in O-Scores, females scored higher.

19. Recommendations

For Educational Institutions and Policymakers

1. Promote Gender-Specific Interventions:
Implement programs that address the gender gap in creativity, encouraging Males to participate more actively in creativity-focused activities while leveraging the strengths of Females.

2. Encourage Creative Activities Across Mediums:
Provide equal access to creative resources and opportunities in both English and Marathi medium schools, as the medium of instruction does not influence creativity.

3. Design Gender-Inclusive Curricula:
Incorporate activities and exercises that encourage both Males and Females to engage in creative thinking, such as group projects, brainstorming sessions, and innovation challenges.

4. Foster Creativity Beyond Traditional Assessments:
Introduce non-verbal and divergent thinking assessments alongside traditional methods to holistically evaluate students' creativity.

5. Target Creativity in Early Grades:
Begin fostering creative thinking skills at earlier grades to build a strong foundation before the ninth grade.

For Teachers:

1. Enhance Non-Verbal Creative Thinking:
Integrate visual arts, hands-on projects, and design-based learning into everyday teaching practices to promote non-verbal creativity.

2. Conduct Professional Development for Teachers:
Organize workshops and training programs to equip teachers with techniques for nurturing creativity across genders and mediums.

3. Encourage Peer-Learning Opportunities:
Facilitate group work and peer-learning sessions where students can exchange creative ideas, fostering collaboration and mutual learning.

For Researchers:

1. Investigate Socio-Cultural Influences:
Study socio-cultural factors contributing to the observed gender differences in creativity to design effective, targeted interventions.

2. Expand Creative Thinking Frameworks:
Develop and test new frameworks, such as problem-solving competitions, collaborative exercises, and gamified learning, to enhance non-verbal creativity.

3. Focus on Longitudinal Studies:
Conduct research to explore how creative thinking evolves over time and how early interventions can affect performance in later grades.

For Students:

1. Participate in Creativity-Enhancing Activities:

Engage actively in art contests, STEM (Science, Technology, Engineering, and Mathematics) projects, and innovation challenges to improve both verbal and non-verbal creative thinking skills.

2. Collaborate Across Genders and Mediums:

Participate in cross-medium and cross-gender collaborative activities to gain exposure to diverse perspectives and enhance creativity.

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